

## V - DATA COLLECTION AND COMMUNICATION NETWORK

### 5-01 Hydrometeorological Stations.

a. **Facilities.** The Corps of Engineers, Los Angeles District (SPL) and San Bernardino County Public Works and Flood Control District (SBCPW&FCD), and U.S. Geological Survey (USGS) each maintain and collect data from precipitation, streamflow, and reservoir water level gages located throughout the Seven Oaks watershed, at the dam, and in adjacent areas. Most of the gages are equipped with radio telemetry that provides water control managers with real-time information about watershed conditions and the status of Seven Oaks Dam. The telemetry networks and all of these gaging stations are described in detail below.

(1) **At Seven Oaks Dam.** Hydrologic facilities that provide both useful and necessary information for operation of the dam consist of a reservoir level monitoring system, data logger, Automatic Local Evaluation in Real-Time (ALERT) transmitter, SPL Los Angeles Telemetry System (LATS) transmitter, and reservoir level staff gages. Table 5-1 provides a summary of the hydrologic instrumentation currently existing at Seven Oaks Dam. The instrumentation at the dam includes a Design Analysis Model H-350/355 pressure transducer/data logger, which is used to measure the reservoir pool elevation and record information on a linear flash card. A computer equipped with a standard PCMCIA card reader can read data stored on the flash card. A design Analysis Model H-500-XL, receiving the reservoir pool elevation from the H-350/355, operates the High Sierra Electronics ALERT radio. The LAD WCDU personnel and personnel from Design Analysis provided training to the San Bernardino County project operators, on site, for better understanding of the water surface measuring, data logging and telemetry features of the equipment.

A 4-inch conduit connects the instrument house to a series of orifice line termination points (pull boxes installed during construction) along the embankment. Six orifice lines have been installed inside the 4-inch conduit to connect the pressure

transducer (H-350) to termination points on the upstream face of the embankment. The lowest termination point, and therefore, the lowest water level that can be sensed, is currently elevation 2120 feet, NGVD. The other termination points are located at elevations 2150, 2180, 2220, 2260, and 2300 feet, NGVD. As sediment deposition occurs over the life of the project, the lower orifice lines buried by sediment will be abandoned and orifice lines connected to higher termination points will be utilized. *[Note: It is the responsibility of the local sponsor to switch to higher orifice lines as needed to ensure that the orifice lines in use are always above the sediment level].* In the instrument house, the orifice lines connect to a multi-port valve (Design Analysis H-390) that allows the H-350 pressure transducer to monitor up to 4 orifice lines at a time.

Besides logging the reservoir water level data on a flash card, output from the H-350/355 is fed into a SBCPW&FCD ALERT transmitter and into a SPL LATS remote telemetry unit (RTU) for radio transmission. This configuration provides two redundant sources of real-time data from the dam. The ALERT and LATS transmitters are co-located with the H-350/355 inside the instrument house on top of the dam.

Staff gages are located on the upstream face of the dam from elevation 2105 to 2610 feet, NGVD. The staff gages are positioned such that from elevation 2105 to 2300, the gages can be read by the dam tender from the service area behind the intake structure; from elevation 2305 to 2400, the gages can be read from top of dam at station 23+00; and from elevation 2405 to 2610, the gages can be read from the instrument house. A staff gage is also installed on the concrete intake structure from elevation 2264 to elevation 2301.

## **(2) SBCPW&FCD Facilities Within and Near Seven Oaks**

**Watershed.** San Bernardino County Public Works and Flood Control District (SBCPW&FCD) maintains a network of precipitation gages throughout the county. Precipitation data is collected from seven stations within the Seven Oaks Dam

drainage area as shown on Plate 5-01. Table 5-4 provides a listing of these gages. The gage located at Manzanita Flat is co-located with the Corps of Engineers LATS stations. The precipitation gage located at Manzanita Flat is equipped with both ALERT and LATS transmitters that can provide real-time precipitation data to the Seven Oaks Dam water control managers. The Heart Bar station is located close to the Corps gaging station of the same name. The precipitation gages located at Big Bear Dam and Camp Angelus stations are operated in conjunction with the NWS.

**(3) Corps Facilities Within and Near Seven Oaks Watershed.** The Corps of Engineers, Los Angeles District maintains hydrometeorological gaging stations within and near the Seven Oaks Dam basin that are part of LATS, as shown on Plate 5-01. Covering the Seven Oaks Dam drainage area, these LATS stations consist of rain gages at Heart Bar, Converse Fire Station, Big Bear Ranger Station and Manzanita Flat and one other COE operated stream gage upstream of the dam at the Southern California Edison bridge crossing (Table 5-2). These gages collect and transmit real-time data using on-site remote terminal units (RTU).

**(4) US Geological Survey (USGS) Stations.** The USGS operates, maintains, and publishes data for two Santa Ana River stream gages located below the dam. These gages are equipped with GOES satellite telemetry Data Collection Platforms (DCP). Station 11051499 Santa Ana River near Mentone (River Only) measures flow in the main channel and Station 11051502 is a supplemental gage which measures flow diverted from the main channel about 250 feet upstream of Station 11051499. Station 11051499 is also equipped with a SPL LATS RTU which reports real-time stage and precipitation. The diverted water passes through the existing percolation basins, which are maintained by the San Bernardino Valley Water Conservation District.

**b. Reporting.**

(1) **Manual.** The dam tender observes water surface elevations, piezometer readings, and gate settings and logs them on a form similar to the one shown on Figure 5-01. These readings are reported to the water control managers via radio or telephone. During the non-flood season (June 1 through November 14), these readings may be taken as often as once a week, on a designated day. During the flood season (November 15 through May 31), they are taken daily Monday through Friday. During flood operations, they are taken as often as the water control managers deem necessary.

(2) **ALERT.** ALERT is a real-time flood warning system operated by local county agencies in cooperation with the National Weather Service. ALERT stations use line-of-sight radio to transmit real-time rainfall and water level data to agencies equipped with reception equipment. ALERT stations report at least once or twice a day during all conditions but report much more frequently in response to storm or runoff events. During an event, ALERT stations automatically sends reports after a threshold value is measured by the gage. The threshold criteria for event reporting from the ALERT stations is established by San Bernardino County Public Works and Flood Control District for the gages that are part of the San Bernardino County system. In the case of the station at Seven Oaks Dam, the threshold criteria is set based upon agreement with the Seven Oaks Dam water control managers, depending upon real-time operational requirements at the dam and for data collection.

(3) **LATS.** LATS is a radio telemetry system operated and maintained by the Corps of Engineers, Los Angeles District. LATS stations operate in three modes: self-time reports, event reporting, and polled. For the Los Angeles District's projects, the general criteria for reporting is every 0.04-inch of ran for rain gages or  $\pm 0.25$  for reservoir and stream level gages. Stations may be programmed to report more frequently or following smaller changes in elevation. The information collected through LATS is transmitted by a line-of-sight radio contained in the RTU to a

repeating station. The Keller Peak repeating station is used by the Seven Oaks basin gages except for the Converse and Santa Ana River at Mentone stations that use the Pleasants Peak repeater. The repeater relays the data to the Corps' Water Control Data System by microwave link. Any LATS gage can be polled (interrogated) by the LAD's Reservoir Operation Center (ROC) personnel for data at any time via the LATS Central Computer. All telemetry data collected by the Corps' LATS system is stored in databases and made available on the Internet at the Los Angeles District Reservoir Regulation Section Web Site ([www.spl.usace.army.mil](http://www.spl.usace.army.mil)). In addition, this data is converted to the ALERT message format and sent to the Orange County Public Facilities and Resources Department for inclusion in their ALERT database.

(4) **GOES**. The GOES data collection system is satellite telemetry system that supports federal, state and local agencies. GOES Data Collection Platforms (DCPs) transmit stream levels and other data to satellites operated by the National Oceanic and Atmospheric Administration. The satellites relay the data to agencies equipped with either a DOMSAT or Direct Readout Ground Station. The stream levels for both USGS stream gages located below Seven Oaks Dam are collected at fifteen-minute intervals and transmitted every four-hours by GOES DCPs. The data is available to the public via the USGS web site (<http://waterdata.usgs.gov/ca/nwis/rt>).

(5) **Weather Data**. The National Weather Service (NWS) provides an array of weather data, including Quantitative Precipitation Forecasts, short and long-range forecasts, precipitation totals, watches and warnings, and severe weather statements. Weather information is provided in forecasted and real-time formats, which can be accessed on their web site.

c. **Maintenance**. All of the three Local Sponsors are responsible for the maintenance of all gages and/or telemetry radio or microwave equipment, with the exception of the of the LATS equipment, which is maintained by the Corps of Engineers, Los Angeles District.

## 5-02 Sediment Stations.

a. **Facilities.** The USGS maintains two sediment stations on the Santa Ana River. One is at E Street near San Bernardino (USGS #11059300) and the other is at 5th Street in Santa Ana (USGS #11078000). The periodic sediment stations use U.S. Depth Integrating Samplers, which accumulate a water-sediment sample as the sampler is lowered to the streambed and raised to the surface at a uniform rate.

b. **Reporting.** The USGS collects, compiles, and publishes sediment data on an annual basis in the publication: Water Resources Data for California.

c. **Maintenance.** The USGS has maintenance responsibilities with respect to sediment stations.

**5-03 Water Quality Monitoring.** The local sponsors perform water quality monitoring in the reservoir as part of their operation and maintenance responsibilities. Details of monitoring responsibilities are provided in the Seven Oaks Dam Operations and Maintenance Manual, Volume I, Part II, Chapter 4, entitled “Environmental Commitments and mitigation”. The U.S. Fish and Wildlife Service, the Santa Ana Watershed Project Authority (SAWPA), the California Regional Water Control Board, and local water agencies monitor the various aspects of water quality in the Santa Ana River basin.

In 1991, the U.S. Geological Survey began a full-scale National Water-Quality Assessment (NAWQA) Program. The goals of the NAWQA Program are to: 1) Describe current water quality conditions for a large part of the Nation's freshwater stream and aquifers (water-bearing sediments and rocks); 2) Describe how water quality is changing over time; and, 3) Improve understanding of the primary human factors affecting water quality. The Santa Ana Basin is one of several NAWQA study units that began in 1997. The Santa Ana NAWQA study unit covers an area of about 2,700 square miles in parts of Orange, San Bernardino, Riverside, and Los Angeles

Counties. The study unit is home to more than 4 million people who not only rely on water resources that originate within the basin, but also on water imported from northern California and the Colorado River.

Other agencies studying the water quality within the Santa Ana Basin include, but not limited to, the following:

- California Air Resources Board
- California Department of Fish and Game
- California Regional Water Quality Control Board, Santa Ana
- California Department of Water Resources
- Chino Basin Water Master
- City of Corona City of Lake Elsinore, Lake Operations
- City of Riverside, Department of Public Works
- City of San Bernardino
- Eastern Municipal Water District
- Inland Empire Utilities Agency (IEUA)
- Lake Arrowhead Community Services District
- Metropolitan Water District
- Orange County Water District
- Riverside Highland Water Company
- Riverside Water Quality Control Plant
- San Bernardino Valley Municipal Water District
- San Bernardino Valley Water Conservation District
- Santa Ana Watershed Project Authority (SAWPA)
- Southern California Coastal Water Research Project

In general, the quality of surface and ground water in the Santa Ana Basin becomes progressively poorer as water moves along hydraulic flow paths. The highest quality water is typically associated with tributaries flowing from surrounding mountains and ground water recharged by these streams. Water quality is altered by a

number of factors including consumptive use, importation of water high in dissolved solids, runoff from urban and agricultural areas, and the recycling of water within the basin.

**a. Facilities - USGS Basic Fixed Site Network.** In 1999 the Santa Ana NAWQA study team began a three-year intensive investigation of water quality conditions along the Santa Ana River and its tributaries. Water quality measurements are obtained at 7 locations, of which 5 are "basic-fixed sites" (BFS) and 2 are "intensive-fixed sites" (IFS). Five of the sites are located in the Inland Santa Ana Basin, and 2 are located in the Coastal Santa Ana Basin. No fixed sites are planned for the San Jacinto Basin due to the lack of surface-water flow during most of the year. The USGS currently monitors discharge at 5 sites. The Basic-Fixed sites network is shown on Plate 5-02, and the following are photos showing these sites where samples are taken.



**South Fork Santa Ana River**



**Santa Ana River near Mentone**



**Warm Creek near San Bernardino**



**Santa Ana River at MWD**



**Cucamonga Creek near Mira Loma**



**Santa Ana River below Prado Dam**



**Santa Ana River SPRD Div below Imperial Highway**

Basic-fixed and intensive-fixed sites are sampled for the analysis of major ions, nutrients, dissolved organic carbon, suspended organic carbon, and suspended sediment. At the IFS sites, the samples will also be analyzed for volatile organic compounds and pesticides. A continuous record for discharge, specific conductance, and water temperature will be measured at all sites. Field measurements will be taken at the time of water quality sampling for specific conductance, pH, dissolved oxygen, and alkalinity.

**b. Reporting.** The river basin and aquifer summary reports prepared by NAWQA as part of the NAWQA program is entitled, "Water Quality in Santa Ana

Basin." A new report is generated for every assessment that has been completed for water quality. There are currently 51 assessments for water quality. With every report generated, there are also summary reports that are part of the USGS Circular series of publications, which are posted on the USGS web site. The water quality reports may also be ordered free of charge upon request. The USGS data is also published each water year in Water Resources Data for California.

Outside of USGS, other agencies that collect water quality data publish annual summaries of their findings. Data collected by the DWR and the CRWQCB, are published annually on microfilm by the State of California Water Data Information System (WDIS).

c. **Maintenance**. The USGS has maintenance responsibility for the water quality station within the Santa Ana basin.

**5-04 Recording Hydrologic Data**. Each agency maintains records of its own data. Water surface and gate settings are observed by the project operators at the dam and recorded on a form such as the one shown on Figure 5-01. These observations are reported to the water control managers in the office either by telephone or radio. During flood events, the project operators report by radio or telephone, as often as is required by the water control managers. There is one ALERT station, located at Manzanita Flat, as shown on Plate 5-01, that records data at the same time that they are being sent via ALERT transmitters from the station site to the water control managers in the office. Rainfall data from SBCPW&FCD precipitation gages are published on their web site ([www.co.san-bernardino.ca.us/trnsprtn/pwg](http://www.co.san-bernardino.ca.us/trnsprtn/pwg)) or can be requested through written correspondence.

The Corps of Engineers LATS telemetry data (i.e. precipitation, water surface, and river stage) collected for the Seven Oaks Dam basin can also be viewed on the Corps of Engineers, Los Angeles District Reservoir Regulation Section web site ([www.spl.usace.army.mil](http://www.spl.usace.army.mil)).

Rainfall data at Big Bear Dam and Camp Angelus are published in the U.S. Weather Service's monthly publication entitled "Climatological Data" and annually on CD-ROM (hydrodata).

Daily flows at the downstream gaging station, "Santa Ana River near Mentone" are published annually in the "Water Resources Data California" and on the Hydrodata CD-ROM from Hydrosphere, Inc.

**5-05 Communication Network.** The Seven Oaks Dam water control managers' project operating center communicates with its project operators via either telephone or the San Bernardino County radio system. Project operators at Seven Oaks Dam also retain the capability to communicate with the Corps' Reservoir Operation Center using the Corps of Engineers' radio system.

**5-06 Communication with Project.**

**a. Communication Between Water Control Managers and Seven Oaks Dam Project Operators.** Communication between the Seven Oaks Dam water control managers and the project operators is accomplished via telephone or radio. In the event that all communications between the water control managers and the project operators are interrupted, a set of "Standing Instructions to the Project Operator for Water Control" have been compiled and included as part of this manual (See Exhibit A). A copy of this Water Control Manual should also be kept at Seven Oaks Dam.

**b. Communication Between Seven Oaks Dam Water Control Managers and the Corps of Engineers.** Seven Oaks Dam was designed to be operated in conjunction with Prado Dam to provide flood protection to the areas along the lower Santa Ana River. Since the operation of Seven Oaks Dam will affect the operation of Prado Dam, the Seven Oaks Dam water control managers must notify the Corps of Engineers, Los Angeles District, Reservoir Operation Center (ROC), of any changes

in releases from Seven Oaks Dam that is beyond releases made for downstream water users. The ROC can also be reached for regulation consultation, if necessary, via telephone or by radio using the Corps of Engineers' radio system. The radio call sign for contacting the Reservoir Operation Center on the Corps of Engineers' radio system is "WUK 4ROC".

**c. Communication Between Seven Oaks Dam Water Control Managers and Others.** The Seven Oaks Dam water control managers are responsible for making telephone notifications to various in-house sections, county agencies, city authorities, private party stakeholders, or any entity with a legitimate need for the information, when any operations at Seven Oaks Dam may impact people or property. The Seven Oaks Dam water control managers shall maintain this list of notifications similar to the list included in Exhibit H, and shall update the points of contacts and phone numbers as needed, and at least annually. The water control managers shall maintain a record of all notifications made and store the records for the life of the project. All notifications must be made prior to making any adjustments that will impact the surroundings of the project. The notifications list should also include the U.S. Army Engineer Research and Development Center, Waterways Experiment Station (WES). WES requires notifications, as early in advance as possible, when target testing elevations will be achieved in the reservoir. This will provide an opportunity for WES to collect data for the prototype testing program to evaluate the performance of the outlet works during flood operations.

**d. Communication Between Seven Oaks Dam Project Operators and Others.** No routine communication is required between the Seven Oaks Dam project operators and other agencies. However, the Seven Oaks Dam water control managers and the project operators may agree that the project operators will make some of the notifications discussed above under the heading "Communication Between Seven Oaks Dam Water Control Managers and Others". If there is no such agreement, the responsibility remains with the water control managers. The project operators will maintain a record of all notifications made and furnish it to the water control

managers, who shall maintain the comprehensive records of all notifications made and shall store them for the life of the project.

**5-07 Project Reporting Instructions.** The Seven Oaks Dam project operators observe water surface elevation and gate settings and report them to the Seven Oaks Dam water control managers via telephone or radio. Currently, there is no precipitation gage at the dam itself, other than the one located downstream of the dam. The data from this precipitation gage is available for real-time operation via telemetry. If an operation, such as, a change in discharge is required by the water control managers, the project operator will perform the operation and then report back to the water control managers to confirm that the operation has been completed. This confirmation will also be accompanied by a new gate setting and water surface elevation report. Any gate operation, for whatever reason, must be reported to the water control managers prior to the operation. No gate operation will be performed without the permission of the water control managers.

During the non-flood season (June 1 through November 14) the standard reservoir observation will be performed at least once a week. During the flood season (November 15 through May 31) this will be performed at least once a day during the project operators' normal work-week. At any time of the day or year, if, based upon meteorologic or hydrologic forecasts, the water control managers expect significant inflow into the reservoir, they shall request the presence of a project operator. A project operator is required to be present at the dam, furnish reports, and perform operations any time the water control managers request it. During flood events, the project operators perform the above described observations and operations and reports them by radio or telephone to the water control managers, as often as the water control managers require it. All reports called in by the project operators should be documented on a reservoir operation report form similar to the one shown on Figure 5-01, and the records kept by the OCPF&RD water control managers.

At the end of the water year (1 October to 30 November), the OCPF&RD water control managers are required to provide a compilation of all data collected during the water year, in a form of a report to the Corps of Engineers, Los Angeles District, Reservoir Regulation Section (SPL). The date(s) of the significant event(s), the water surface elevation(s), and inflow and outflow data must be provided in the report. In addition, some discussion should be provided to describe any problems that may have been encountered during the implementation of the water control plan, any coordination between agencies, and necessary notifications that have been made during the event(s). Information provided will be included as part of the Corps' annual water control management report that discusses the regulation of Corps owned and Section 7 reservoirs, including Seven Oaks Dam.

**5-08 Warnings.** The responsibility for issuing all weather watches and warnings and all flood flash flood watches and warnings rests with the National Weather Service. Local, state, county and city emergency management official are responsible for issuing any public warnings regarding unusual overflows, evacuations, unsafe roads or bridges, toxic spills, etc. The OCPF&RD water control managers will be required to make notifications to local authorities when critical water surface elevations are reached, and critical release rates are initiated. Notification requirements for coordinating releases with the Corps of Engineers, Reservoir Operation Center (ROC) are described in section 5-06.b. Notification requirements for operations that impact people or property are described in Section 5-06.c. In the event of a dam break, the water control managers should refer to the Emergency Action and Notification Subplan notebook for Seven Oaks Dam. This subplan must be available at the Storm Operation Center. Copies are also located in the ROC and the LAD's Emergency Operations Center (EOC), at the Corp of Engineers, Los Angeles District office.

**Table 5-1  
Hydrologic Instrumentation at Seven Oaks Dam**

Parameter	Gage Type	Report Mode	Stored Record	Comments
WATER SURFACE ELEVATION	Staff Boards at Dam	Visual Inspection	Flood Control Basin Operation Report SPL 19 or Equivalent	Bubbler System with Multiple Orifice Lines
	Design Analysis H-350 Combination Pressure Transducer/Data Logger *	Data Logger	Flash Card	
		ALERT Telemetry	County ALERT Reception Systems	
		LATS Telemetry	Corps Telemetry Database	
DOWNSTREAM GAGE HEIGHT	Pressure Transducer	LATS and GOES Telemetry Visual Inspection	USGS Records Corps Telemetry Database	USGS Gage 11051500 USGS Gage 11051502** USGS Gage 11051499**
PRECIPITATION	Novalynx Tipping Bucket	LATS Telemetry and Data Logger	Corps Telemetry Database San Bernardino County Records	Precipitation gage is co- located with downstream stream gage

\*\*Equipped with GOES DCP

**Table 5-2  
Streamgages Pertinent to Seven Oaks Dam**

	Location	Drainage Area* (mi <sup>2</sup> )	Latitude	Longitude	Elev (ft)	Period of Record	Remarks
1	Santa Ana River Near Mentone, CA #11051500** USGS (LATS) RTU 57	210	34-06-30	117-05-59	1,950	07/1896-pr	In San Bernardino County, on right bank near mouth of canyon, 1.6 mi. u/s from Mill Cr, 3.2 mi. NE of Mentone, 16 mi d/s from Big Bear L.
2	Santa Ana River above Seven Oaks Dam Corps of Engineers (LATS) RTU 85	161	34-08-33	117-04-08	2,550	10/1997-pr	Located on right bridge abutment of the S. Cal. Edison bridge crossing, just u/s of Alder Cr. confluence

See plate 5-01 for locations.

\*Drainage area includes 38 sq. mi. non-contributing area from Baldwin Lake.

\*\*Is a combination of two USGS gages #11051499 and #11051502 that monitor the downstream flow. Both of these gages are equipped with GOES DCPs.

**Table 5-3  
COE LATS Rain Gages Pertinent to Seven Oaks Dam**

No.	Location	RTU ID	Latitude	Longitude	Elevation (ft)	Period of Record
1	Big Bear Lake Ranger Station	84	34-16-58	116-54-07	6,940	11/1995-pr
2	Manzanita Flat	82	34-09-36	117-02-47	3,920	11/1995-pr
3	Heart Bar	83	34-09-31	116-46-56	6,690	11/1995-pr
4	Converse Fire Station	25	34-11-38	116-54-49	5,600	1/1992-pr
5	Santa Ana R. nr Mentone	57	34-06-30	117-05-59	1,950	07/1896-pr

See plate 5-01 for locations.

**Table 5-4  
SBCFCD Active Rain Gages Pertinent to Seven Oaks Dam**

No.	Location	SBCFCD Station ID	ALERT ID	Latitude	Longitude	Elevation (ft)	Period of Record (WY)
1	Big Bear Community Svcs. Dist.	6091A	-	34-15-41	116-50-39	6,800	1950-pr
2	Big Bear Hospital	6363	-	34-14-46	116-53-09	6,800	1981-pr
3	Big Bear Dam	6032	-	34-14-29	116-58-31	6,815	1884-pr
4	Camp Angelus	3260	-	34-09-00	116-59-02	5,780	1967-pr
5	Santa Ana Powerhouse #3	3162	-	34-06-28	117-05-56	1,950	1922-pr
6	Manzanita Flat	3002	2833	34-09-36	117-02-47	3,920	11/1995-pr
7	Heart Bar	3259	-	34-09-31	116-46-56	6,690	11/1966-pr
8	Fawnskin	6334	-	34-16-01	116-57-10	6,280	1974-pr

See plate 5-01 for locations.

SBCFCD - San Bernardino County Public Works and Flood Control

COE - Corps of Engineers